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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/987,001	11/13/2001	Yoshinori Odake	60188-402	6382

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EXAMINER

BOOTH, RICHARD A

ART UNIT	PAPER NUMBER
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2812

DATE MAILED: 03/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/987,001

Applicant(s)

ODAKE ET AL.

Examiner

Richard A. Booth

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 December 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) 10 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 11-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 11/13/01.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election with traverse of group I is acknowledged. The traversal is on the ground(s) that claim 8 depends on claim 10 and therefore claim 10 should also be examined. This is not found persuasive because claim 8 depends on claim 1.

The requirement is still deemed proper and is therefore made FINAL.

Claim Objections

Claim 11 is objected to because of the following informalities: in claim 11, line 7, after "etching" the word "of" should be inserted for proper grammar. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-9 and 11-17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, lines 20-21, claim 3, lines 2-3, claim 5, line 3, claim 6, lines 3-4, claim 7, line 3, claim 11, line 3, claim 12, lines 3-4, claim 15, lines 2-3, and claim 16, line 3, the phrase "the ion injection adjustment film" lacks antecedent basis since claim 1, line 10 recites "ion injection adjustment films". For the sake of examination, it is assumed

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that it was intended to claim a single ion injection adjustment film until applicant in dependent claims more positively recites multiple films (see, for example, claim 16).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-6, 8-9, and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by Doi et al., U.S. Patent 6,472,281.

Doi et al. shows the invention as claimed including a method for fabricating a nonvolatile semiconductor memory device, comprising: a first step of forming a gate structure on a semiconductor substrate 11, the gate structure comprising a tunnel insulation film 12 being in contact with the semiconductor substrate, a floating gate electrode 20 being in contact with the tunnel insulation film, a control gate electrode 22 facing the floating gate with an intervening capacitive insulation film 21; a second step of forming an ion injection film 19 comprising an insulation film being in contact with the floating gate electrode at least on side surfaces of the floating gate electrode; a third step of injecting an impurity 23 into active regions beside the gate structure in the semiconductor substrate by using the gate structure and the ion injection film 19 as

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masks; and a fourth step of thermally diffusing the injected impurity ion by performing heat treatment on the active regions; wherein, in the second step, the film thickness of the ion injection adjustment film is chosen so as to prevent the impurity ion from being injected into the tunnel insulation film and to allow the impurity ion to reach a portion below a side end portion of the floating gate electrode in the active regions as a result of diffusive scattering of the impurity ion into the semiconductor substrate (see figs. 4(a)-4(c) and col. 10-line 5 to col. 11-line 27).

Regarding claims 2-4, note that the heat treatment of the fourth step can be conducted in an oxidizing atmosphere at a temperature of eight hundred fifty Celsius and the ion injection film is composed of a material having oxygen permeability, and the fourth step includes a step of oxidizing an upper portion of the active region, and of oxidizing a part of the floating gate electrode by using oxygen transmitted through the ion injection film (see col. 14-line 54 to col. 15-line 33).

With respect to claim 5, note that the thickness of the ion adjustment film is 10nm (see col. 10-lines 26-31).

Concerning claim 6, note that in the embodiment of figs. 5a-5c the ion adjustment film is formed on the entire surface of the semiconductor substrate including the gate structure and a step of exposing the active region by performing anisotropic etching on the deposited ion injection adjustment film is included (see col. 11-line 29 to col. 13-line 6).

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Regarding claims 8-9, the third step can include multiple ion implantation steps on opposing sides of the gate structure (see col. 12-lines 28-35) which can be two different types of ions such as arsenic and phosphorous (see col. 21-lines 9-18).

With respect to claim 15, note that the ion injection adjustment film can be silicon nitride (see col. 12-lines 62-63).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al., U.S. Patent 6,472,281 in view of Doi et al., U.S. Patent 6,368,907.

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Doi et al. '281 is applied as above but fails to show an ion adjustment film formed through thermal oxidation.

Doi et al. '907 disclose forming an ion adjustment film 22 through thermal oxidation (see figs. 3(d)-4(b) and col. 10-line 35 to col. 11-line 7). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the primary reference of Doi et al. '281 so as to include an ion adjustment film formed through thermal oxidation as disclosed by Doi et al. '907 because such method is suitable for forming a silicon oxide film to be formed on a stacked structure.

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al., U.S. Patent 6,472,281 in view of Chen et al., U.S. Patent 6,232,183.

Doi et al. is applied as above but fails to expressly disclose a step of masking the ion adjustment film on one side surface of the gate structure while exposing the ion injection adjustment film on the other side surface of the gate structure, and a step of performing anisotropic etching the ion injection adjustment film being exposed on said other side surface of said gate structure.

Chen et al. discloses a step of masking the ion adjustment film 518 using a mask 520 on one side surface of the gate structure while exposing the ion injection adjustment film on the other side surface of the gate structure (see fig. 5D), and a step of performing anisotropic etching the ion injection adjustment film being exposed on said other side surface of said gate structure (see fig. 5E and col. 4-line 20 to col. 5-line

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35). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Doi et al. so as to perform the etching process of Chen et al. because such a process reduces the channel length which leads to improved device characteristics.

Claims 11-12 and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al., U.S. Patent 6,472,281 in view of Pham et al., U.S. Patent 6,248,627.

Doi et al. is applied as above but fails to expressly disclose a step of masking the ion adjustment film on one side surface of the gate structure while exposing the ion injection adjustment film on the other side surface of the gate structure, and a step of performing anisotropic etching the ion injection adjustment film being exposed on said other side surface of said gate structure, a step of adjusting the film thickness of the ion injection adjustment film by etching after anisotropic etching, forming multiple adjustment films of oxide and nitride, and removing a lower end portion of the second adjustment film after forming the second adjustment film.

Pham et al. discloses a step of masking the ion adjustment film 44 on one side surface of the gate structure while exposing the ion injection adjustment film on the other side surface of the gate structure, and a step of performing anisotropic etching on the ion injection adjustment film being exposed on said other side surface of said gate structure (see fig. 5), a step of adjusting the film thickness of the ion injection adjustment film by etching after anisotropic etching (see fig. 6), forming multiple

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adjustment films containing oxide and nitride, and removing a lower end portion of the second adjustment film after forming the second adjustment film through etching (see figs. 2-6 and col. 2-line 55 to col. 4-line 3). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Doi et al. so as to include the adjustment film process of Pham et al. because such a structure protects the gate edges from charge loss.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al., U.S. Patent 6,472,281 in view of Ogura et al., U.S. Patent 5,650,345.

Doi et al. is applied as above but fails to expressly disclose wherein the first step includes a step of forming a protective insulation film on the control gate electrode.

Ogura et al. discloses forming a protective insulation film 20 overlying a control gate electrode 18 (see col. 3-lines 53-67). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Doi et al. so as to include the protective insulating layer of Ogura et al. in order to prevent the control gate electrode from oxidation.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al., U.S. Patent 6,472,281 in view of Sobek et al., U.S. Patent 6,268,624.

Doi et al. is applied as above but fails to expressly disclose forming multiple adjustment films of oxide and nitride.

Sobek et al. discloses forming ion adjustment films of silicon oxide and silicon nitride 30 on a gate structure (see figs. 2-3 and col. 3-line 38 to col. 4-line 36). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Doi et al. so as to include the multiple ion adjustment films and form an adjustment film by thermal oxidation as suggested by Sobek et al. because this provides an effective barrier for the gate structure.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Doi et al., U.S. Patent 6,472,281 in view of Odake et al., U.S. Patent 6,030,869.

Doi et al. is applied as above but fails to expressly disclose forming a side wall spacer over the ion adjustment films and implanting a conductivity type opposite the substrate using the adjustment film and spacer as a mask.

Odake et al. discloses forming an insulative spacer 25 over an adjustment film 6 and implanting a conductivity type opposite the substrate using the adjustment film and spacer as a mask (see figs. 2B-3C and col. 7-line 6 to col. 8-line 60). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Doi et al. so as to include the spacer/adjustment film/doping process of Odake et al. because this allows for greater control over the device characteristics.


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Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Richard A. Booth whose telephone number is (571) 272-1668. The examiner can normally be reached on Monday-Thursday from 7:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (571) 272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Richard A. Booth
Primary Examiner
Art Unit 2812

March 4, 2004